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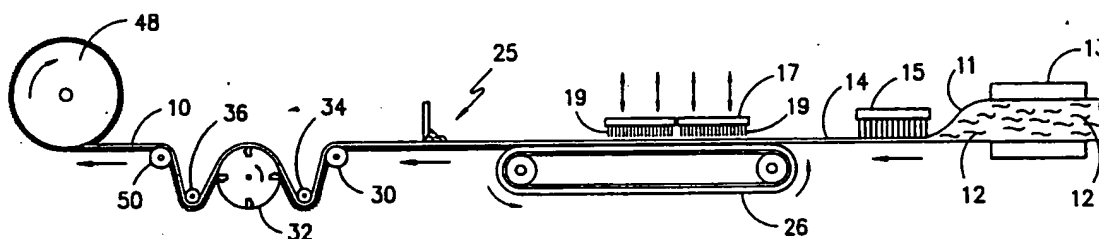
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Glasgow G2 4ER Scotland(GB)(54) **Needled non-woven fabric.**

(57) Method to produce a nonwoven needled fabric in which the needled fabric includes 15 - 30% of low melt nylon 6 and nylon 12 fusible fibers to aid in

holding the nonwoven fabric together when passed through an oven to melt the fusible fibers and then allow them to cool and bind the fabric together.

**FIG. -1-****EP 0 482 749 A1**

This is a continuation-in-part of prior application Serial Number 618,977, filed on November 28, 1990 in the name of Paul William Eschenbach for NEEDLED NONWOVEN FABRIC, which in turn is a continuation-in-part of prior application 603,434, filed on October 26, 1990 of Paul William Eschenbach for CUT PILE NEEDLED NONWOVEN FABRIC.

This invention relates to a nonwoven fabric and a method of making same and, more particularly, to a nonwoven fabric made from a needled batt of non-woven staple fibers from a blend of fibers including low melt fusible fibers.

There has been on the market for many years fabrics having a backing member, such as jute or burlap, or the like, which may or may not have a non-woven batt of staple fibers secured thereto as by the use of adhesive, needle bonding, fusion, or the like. Yarn is tufted through the backing and/or through the batt. The ends of the tufts are then napped, tigered, or cut to produce a fleece-like material, see U. S. Patent No. 3,152,381 issued October 13, 1964 to Priester, et al, and U. S. Patent No. 2,913,803 issued November 24, 1959 to Dodds, or a frieze effect material, see U. S. Patent No. 3,341,386 issued September 12, 1967 to White, et al. All of this prior art has in common the use of tufting to provide looped pile, the loops of which are then napped or cut to product the fabric having a deep soft surface thereon.

U. S. Patent No. 3,674,618 issued July 4, 1972 to Spann discloses a process for making an imitation sliver knit pile fabric wherein a thin thermoplastic film is placed on a non-woven layer of stable fibers. The fibers are needled through the film and the film is thermally bonded to the fibers. The layer of fibers is then napped, sheared and polished to produce an apparel fabric that is soft and pliable.

U. S. Patent No. 3,347,735 issued October 17, 1967 to Sissons shows attaching a reinforcing member to a surface of a web of stable fibers. The web and reinforcing member are needle punched from the side of the web opposite the reinforcing member to force fibers through the reinforcing member to form fiber tufts. The resulting product is immersed in boiling water to crimp the fibers.

U. S. Patent 4,391,866 issued July 5, 1983 to Pickens, et al., describes a cut pile fabric made from a needled batt of non-woven fibers in which a series of loops is aligned in the cross-machine direction and then tigered to break a number of the filaments in the formed loops. Then to even out the surface of the fabric the surface of the fabric is polished and sheared in order to produce a suitable smooth pile surface.

It is therefore an object of the invention to provide a method to provide a pile fabric from a needled non-woven fabric which does not have one or more of the problems inherent in the structures of the above fabrics.

Other objects and advantages of the invention will become readily apparent as the specification proceeds to describe the invention with reference to the accompanying drawings, in which:

Figure 1 is a schematic representation of the process to produce the desired fabric;

Figure 2 is a schematic representation of the loop-forming process;

Figure 3 represents the loop cutting apparatus to cut the loops of the needled fabric.

Figures 4 and 5 represent the two specific ways to cut the formed loops;

Figure 6 is a cross-section view of the fabric with loops formed therein taken on line 6-6 of **Figure 4**, and

Figure 7 is a modification of the process illustrated in **Figure 1**.

Looking now to the drawings, **Figures 1 & 7** schematically represent the preferred embodiments of producing the cut pile fabric. **Figures 1 & 7** show a continuous process but obviously the fabric or webs being processed can be taken up at the end of any step in the process and carried on a roll or like to the next step in the process so long as the sequential steps of the process shown are followed.

Figures 1 - 6 illustrate one preferred form of fabric 10 and the method of manufacturing same. Non-woven staple fibers 12 are laid up in a continuous web 11, as in **Figure 1**, using, for instance, a conventional lapper 13 whereupon as the web 11 is advanced past a needle loom 15, it is needled into a continuous batt 14, using conventional needles. The batt 14 may be needled from both sides or from one side, as shown depending upon the materials of the fibers and the desired weight of the finished fabric. In a preferred form of the steps of manufacture, and assuming that the batt 14 was needled from one side only, which was from above in **Figure 1**, the needled batt 14 may be turned over or reversed before it is fed to a loop-forming needle loom 17. The turning of the batt 14 may be accomplished by rolling the batt onto a roller (not shown) as it leaves the needle loom 15, after which the roller is reversed and the batt 14 is fed to the needle loom 17 so that the batt 14 is punched from the side of the batt opposite to the single needle. If the batt 14 was needled from both sides, it is fed to the needle loom 17 oriented so that the needles penetrate first into the first punched side so that the loops project from the last-punched side. The batt 14 is advanced past the needle loom 17 where it is formed into loops 18. The needle loom 17

uses fork needles 19 which pass through one surface, such as a back surface 20, of the batt 14 to push fibers caught on the ends of the needles through another surface, such as a face surface 22, to form the loops 18 extending from said face surface.

To provide a random effect of the loops 18 as shown in Figure 6 the forked needles are aligned in the transverse direction and staggered in the machine direction so that the openings in the loops in the machine direction are staggered from row to row in the machine. To accomplish this arrangement a brush conveyor 26 is used to allow the staggered needles to pass therethrough randomly after needling and to mount the needles 19 so that the openings in the form run perpendicular to the machine direction of the needle loom 17.

After the loops 18 have been formed in the batt 14 the batt 14 is moved downstream to where a backing 24, such as a coating of latex, Figure 1, or the like, is applied to the back surface 20 using a conventional latex applicator 25 to lock the fibers 12 of the batt 14 and, if particular, the fiber ends of the loop 18 that are still in the batt and to add stiffness to the batt.

The applicator 25, as shown in Figure 1, is a commercially available type which applies the backing 24 as the batt 14 is moved past the applicator with the backing surface facing upward. In place of the latex backing 24, when the nature of the material of the fibers in the batt 14 is thermoplastic or a blended composition containing fusible fibers; or the like, the back surface 20 may have the backing 24 formed by fusing (not shown) using an appropriate heat roll or oven 28 as shown in Figure 7, or the like, which is intended to lock the ends of the fibers forming the loops and to add stiffness to the batt. The backing 21 gives strength and stability, as well as stiffness, to the finished fabric.

From the applicator 25 the backed looped batt 14 (Figure 6) with the staggered loops 18 facing downward is passed over a guide roll 30 to the loop cutting rotor 32 of the type disclosed in U. S. Patent No. 3,977,055. Located on both sides of the rotor 32 are a pair of adjustable rolls 34 and 36 mounted, respectively, in support tracks 38 and 40. Support tracks allow the rolls 34 and 36 to move upward and downward to adjust the position of the looped batt 14 with respect to the blades 42 in the cutting rotor 32. As described in U. S. Patent No. 3,977,055 the blades 42 sever almost 100% of all of the loops 18 with a minimum of waste to provide a cut pile fabric 46. As shown in Figures 4 & 5, the rotor 32 can be driven in the direction of travel of the looped batt 14 (Figure 4) by the motor 44 or opposite to the direction of travel of the batt (Figure 5). After the loops 18 of the batt 14 have

been cut the cut pile fabric 46 is delivered to the take-up 48 by the driven roll 50 whereat it is taken up.

EXAMPLE

A typical fabric made by the herein-disclosed apparatus and method will be comprised of 18 denier, $3\frac{1}{2}$ " staple nylon having a pile height of 4-5 mm. Depending on the use of the cut pile fabric the weight can vary from 6 to 30 oz/yd². If the apparatus of Figure 7 is employed the web 12 can be blended with 3 - 6 denier low melt polyethylene or like fibers.

A plurality of layers of non-woven staple fibers of $3\frac{1}{2}$ " lengths of nylon was lapped into a continuous web 11 which was then needle punched to form a continuous batt 14. The needle punched batt 14 was then punched on a loom 17 to form loops 18. The fork needles 19 used on the needle loom 17 were oriented with the opening between the points of the fork disposed perpendicular to the machine direction. The batt 14 was then moved past applicator 25 whereupon a backing 24 of latex, identified as SBR, was applied on the back surface 20 at the rate of 8 ounces per square yard and was dried. The latexed batt 14 was then passed at the rate of 15 feet per minute through the rotor 32 rotating at suitable r.p.m. in a counterclockwise or clockwise direction to cut the loops 18. The fabric 10 may be dyed in conventional fashion or the fibers 12 may have been stock dyed or solution dyed the desired color so that the finished fabric would reflect that color.

As discussed previously, Figure 7 shows a modification of the invention in which the batt includes a pre-determined amount of low melt fusible fibers which will fuse the batt 14 in the oven 28. The particular low melt fusible fiber and the amount blended is not specifically critical except that in the preferred form of the invention the batt 14 is a blend of 80%, 18 denier $3\frac{1}{2}$ " solution dyed polypropylene fibers and 20%, 6 denier 1-7/8" clear polyethylene. The amount of low melt fusible fiber can vary from 10 - 35% and the amount of remaining fibers shall vary accordingly. In the preferred case above the oven is operated at approximately 275° F for a period of five minutes to heat set the batt 14.

In another form of the invention the product is basically nylon. The major component of the blended batt 14 is 85 - 70% of 18 denier, 3" staple solution-dyed nylon while the low melt fiber is a combination of nylon 6 and nylon 12 which is 15 - 30% of the total batt 14. The low melt nylon combination fibers are 4.5 denier with a staple length of 51 millimeters. The herein-described batt 14 is placed in the oven operating at a temperature

of 300° F and allowed to dwell for about five minutes before being cooled to complete the fusion of the fibers.

The above combination of fibers provides improvement in bearding, higher tensile strength and a high degree of dimensional recovery. This batt is very stable due to the low moisture absorption of the nylon 6 and nylon 12 combination for the low melt staple fiber.

Depending on the use of the nonwoven fabric made by fusing the low melt fibers with the remaining fibers in the batt, numerous treatments may be made. The fabric can be needled to form loops with the loops remaining intact or cut as shown in Figures 1 - 7. The fabric can also be needled only for use as a carpet backing material, etc. The treatment after fusion depends on the ultimate use of the fabric but usually includes a flexing step to make the fusion bonded batt more pliable and/or flexible. This step may include running through a compactor or over an edge to break up the bond of the fibers during or after cooling of the low melt fibers. Another possibility is to employ a set of rotating wheels to work the surface of the batt. All of these treatments are directed to provide pliability to otherwise a stiff, boardy fabric.

Fabrics made by the fusion bonding step of bonding the low melt fibers to the other fibers in the batt provides a fabric which is non-boardy with excellent appearance and can be readily sewn if the use of same requires such.

Although the preferred embodiments of the invention have been described, it is contemplated that changes may be made without departing from the scope or spirit of the invention and it is desired that the invention be limited only by the scope of the claims.

Claims

1. A method of producing a cut pile fabric comprising the steps of: lapping and needling non-woven staple fibers into a batt, needling the batt to produce randomly spaced fibers which are open in the longitudinal direction of the batt, treating the back of the batt after forming loops in the face thereof to secure the formed loops therein, cutting substantially 100% of the loops in the batt and taking up the pile fabric formed after cutting of the loops.
2. The method of Claims 1 wherein the back of the batt is treated with a latex or like material.
3. The method of Claim 1 wherein the batt is formed by blending a plurality of low melt fusible fibers into the batt and treating the batt after forming loops therein by applying a temperature thereto above the melting point of the low melt fusible fibers therein.
4. The method of Claim 1 wherein the loops are cut by a rotor which has blades therein which engage substantially all the filaments in each formed loop.
5. The method of Claim 1 wherein the loops are formed by forked needles aligned in the transverse direction of the batt and staggered in the longitudinal direction of the batt.
6. A system to provide a cut pile fabric comprising: means to lap and needle non-woven staple fibers into a batt, supplying said batt to a needle loom having forked needles, said forked needles being aligned in the transverse direction of said loom and being staggered in the machine direction with the openings in said forked needles being perpendicular to the machine direction of said loom to form staggered loops from said batt when needled by said forks, means to treat the back of said batt to supply rigidity thereto and means to cut substantially all of the loops formed in said batt.
7. The system of Claim 6 wherein said needle loom includes a brush conveyor into which the forked needles project after insertion through said batt.
8. A composite nonwoven fabric: a plurality of one type of staple fibers blended with another type of low melt fusible staple fibers, said low melt fusible fibers having been melted and set to provide cohesion to said composite fabric, said low melt fusible fibers comprising about 10 - 35% of said composite fabric.
9. The fabric of Claim 8 wherein said low melt fusible fibers are a blend of nylon 6 and nylon 12 fibers.
10. The fabric of Claim 9 wherein said one type of staple fibers is nylon.
11. The fabric of Claim 10 wherein said one type of nylon staple fibers is solution dyed.
12. The method of providing a nonwoven fabric comprising: blending synthetic staple fibers with low melt fusible fibers and forming them into a batt, said low melt fusible fibers comprising 10 - 35% of the blend, needling the batt of blended fibers, subjecting the needled batt of fibers to a temperature above the melt-

ing temperature of the low melt fusible fibers for a period of time and allowing the fusible fibers to cool to provide a cohesive composite nonwoven fabric.

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13. The method of Claim 12 wherein the low melt fusible fibers are nylon.

14. The method of Claim 12 wherein the composite fabric is needled again to form loops in one surface thereof.

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15. The method of Claim 14 wherein the loops formed are cut to form a plush or pile fabric.

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16. The method of Claim 15 wherein the low melt fusible fibers are nylon.

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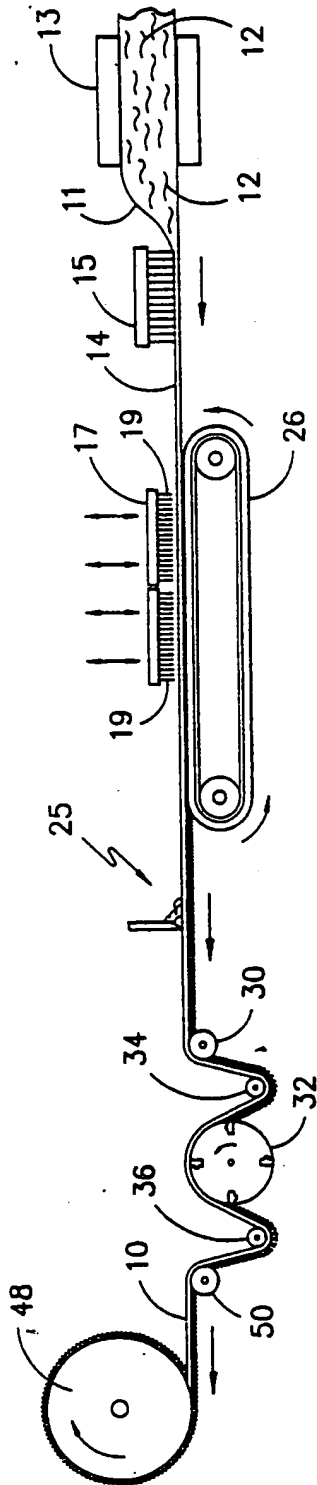


FIG. -1-

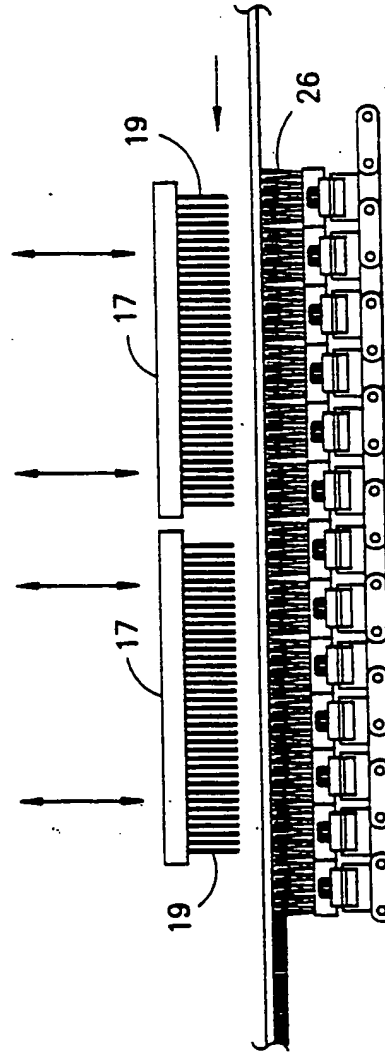


FIG. -2-

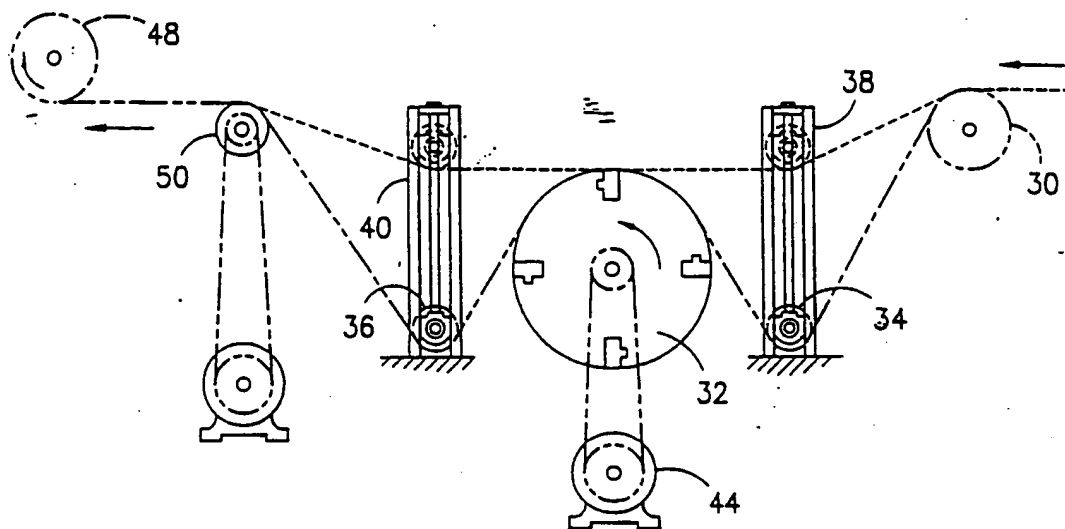


FIG. -3-

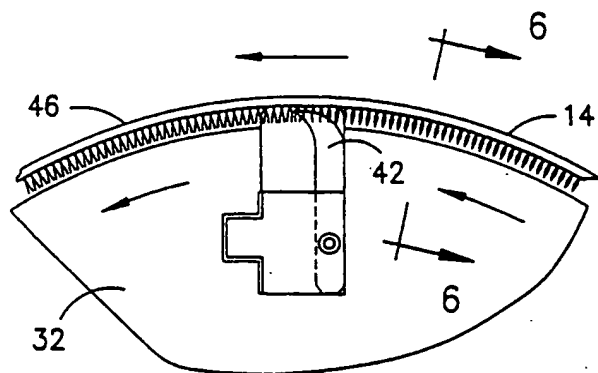


FIG. -4-

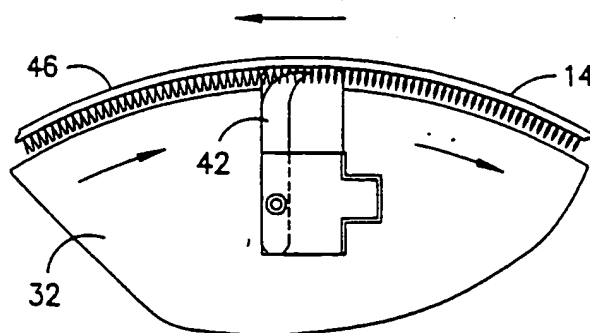


FIG. -5-

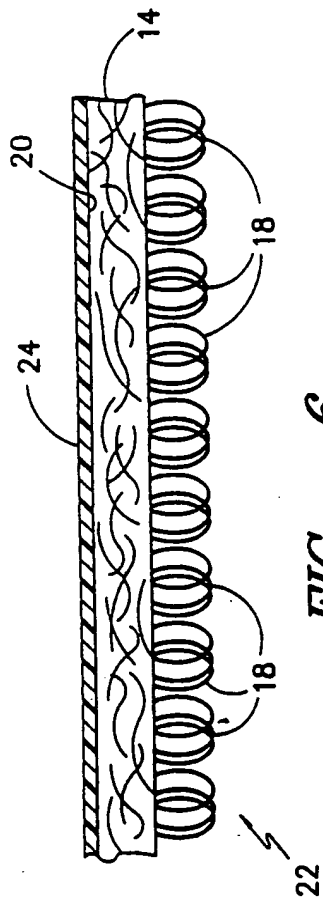


FIG. -6-

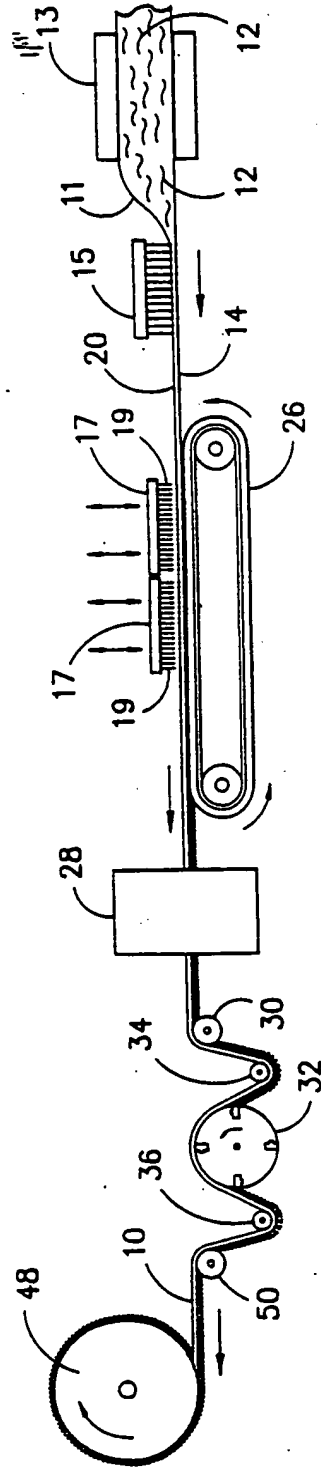


FIG. -7-



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EUROPEAN SEARCH REPORT

Application Number

EP 91 30 8069

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D,Y	US-A-4 391 866 (PICKENS) * column 1, line 50 - column 5, line 43 **	1,3,4,6	D 04 H 11/08 D 04 H 18/00 D 04 H 1/46
D,A	-----	2,5,8-16	
D,Y	US-A-3 341 386 (WHITE ET AL.) * whole document **	1,3,4,6	
D,A	-----	8-10	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D 04 H
The present search report has been drawn up for all claims			
Place of search		Date of completion of search	Examiner
The Hague		11 February 92	HOPKINS S.C.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			